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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/965,096      | 09/27/2001  | Junichiro Fujita     | 6005                | 2689             |

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EXAMINER

VALENCIA, DANIEL E

| ART UNIT | PAPER NUMBER |
|----------|--------------|
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2874

DATE MAILED: 09/13/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/965,096

Applicant(s)

FUJITA ET AL.

Examiner

Daniel E Valencia

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-21 and 24 is/are rejected.
- 7) ☒ Claim(s) 22-23 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 17 January 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

### Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_ 6) ☐ Other:

## **DETAILED ACTION**

### ***Inventorship***

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 21 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 21 to a polarization independent optical isolator/circulator based on a nonreciprocal phase shifter simply lists the essential elements of the device; however, the claim fails to mention or describe the structural relationship between the elements.

Claim 9 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the

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invention. Independent claim 1 recites the limitation “wherein magnetizations of magneto-optical materials in said arms are opposite to each other”. Dependent claim 9 then recites the limitation “directions of magnetization of the Faraday rotators are the same”. It is vague and unclear how the directions of magnetization are the same as well opposite each other.

Appropriate correction is required.

Claims 12, 14, 17, and 22 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The second line of the claims recite the limitation “and/or”. It is vague and unclear what is meant by this limitation. Appropriate correction is required.

Claim 24 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 24 depends on independent claim 21; however, the present claim also refers back to claim 23. Appropriate correction is required.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

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Claims 1-8, 10, and 13-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shintaku U.S. Patent No. 5,905,823. Refer to the appropriate drawings or parts of the specification. Shintaku discloses a polarization independent optical nonreciprocal circuit based on even mode to odd mode conversion with a majority of the limitations of the present invention. Regarding claim 1, Shintaku discloses a polarization-independent optical isolator/circulator (see fig 3 and 5) comprising a two arm interferometer including nonreciprocal phase shifters in both interferometric arms (ref 113-116), wherein a nonreciprocal phase shifter includes a half-wave retarder (ref 115 and 116) and a transverse magnetic mode nonreciprocal phase shifter (ref 113 and 114) including vertically asymmetric magneto-optical waveguides (ref 11) with a transverse magnetic field across each arm, wherein magnetizations of magneto-optical materials in said arms are opposite to each other to create  $\pm 90^\circ$  (col. 1, lines 21-30) nonreciprocal phase shift, allowing the total phase difference between the two arms for forward and backward directions to be different by  $180^\circ$  for both orthogonal polarizations (see col. 1, lines 29-50). Shintaku further discloses different embodiments wherein the isolator/circulator has two input ports and one output ports (fig 1), two input ports and two output ports (fig 5), and one input port and one output port (fig 3), as described by instant claims 2, 4, 5, and 18-20. Referring to claim 3, Shintaku discloses that the isolator/circulator further comprises a  $90^\circ$  reciprocal phase shift in one arm of the interferometer so that the total phase difference is  $0^\circ$  for one propagation direction and  $180^\circ$  for the other propagation direction (see col. 5, lines 44 to bottom and col. 6, lines 1-20). Shintaku further discloses that the nonreciprocal phase a shifter is a Faraday Rotator and a half-wave retarder in both arms, where the principal axis of one retarder has a  $45^\circ$  offset (see col. 5, lines 36-40) from the other, as mentioned by part of instant claim 6. Regarding instant claims 7

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and 8, Shintaku discloses that the magnetizations of the Faraday rotators are opposite (see col. 5, lines 36-40), wherein the rotator crystals are spatially separated to produce a total Faraday rotation of  $45^\circ$  nonreciprocal polarization rotation. Shintaku further discloses that his device uses a Faraday rotator and a half-wave retarder, explained in instant claim 10. Referring to claim 13, Shintaku discloses that his device could further comprise at least one thin-film magnet (see col. 1, lines 13-20) adjacent to the Faraday rotator. Shintaku disclosure depicts the thin film faraday rotator and the thin film half-wave retarder inserted into grooves (see fig 10, 19, and 13) where the films see the optical beam axis of at least one optical path, as described in instant claim 14. Regarding claim 15, Shintaku also discloses that the half-wave retarders further comprises stress-applying films (col. 8, line 10). Shintaku discloses that his device includes collimating lenses (see fig. 17, ref 223) and a variable phase shifter or attenuator (col. 13, lines 13-23), for compensating power, as described in instant claims 16 and 17. Shintaku discloses the same type of optical isolator/circulator as the present inventions; however, Shintaku's device has one Faraday rotator in each interferometer rather than one, and the half-wave retarders have a slow-axis of  $22.5^\circ$  instead of  $45^\circ$ . Shintaku teaches that the same type of result would follow from employing one Faraday rotator in each arm with the same collective shift, as using two different rotators disposed in the same arm to produce the same shift. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute two different rotators in the same arm to produce the same collective shift that one rotator in Shintaku's device would produce.

Another difference between the present invention and the prior art is found in claim 6. Shintaku fails to teach that the rotators and the wave retarders in the interferometric arms are

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arranged in the same order. However, as well known in the art, the components would produce substantially the same result in the light wave, regardless of how they are arranged. It would follow that one of ordinary skill in the art would have known that rearranging the components in the interferometric arm would not change the collective phase shift of the light wave. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to arrange the rotators and the wave retarders in the same order in the device disclosed by Shintaku.

Claims 11 and 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shintaku in view of Frisken U.S. Patent No. 6,014,475. Refer to the appropriate drawings or parts of the specification. Shintaku as applied above, discloses a polarization independent optical nonreciprocal circuit based on even mode to odd mode conversion, with a majority of the limitations of the present invention. Shintaku however; does not teach the use of vertical or horizontal adiabatic taper at any optical interface.

On the other hand, Frisken discloses an optical circulator that teaches the limitation that the Shintaku reference fails to teach. Regarding claims 11 and 12, Frisken discloses that his circulator device comprises vertical or horizontal adiabatic tapers, wherein the taper is made by thermally expanding the core (see col. 3, lines 5-12). Frisken teaches that it is advantageous to use adiabatic tapers when interfacing optical fibers or waveguides, because it reduces distortion (see col. 3, line9). In addition Shintaku discloses that his device uses expanded cores at the optical interfaces of his device (col. 9, line 62). Therefore, it would have been obvious to one of

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ordinary skill in the art at the time the invention was made to thermally expand the core as a way of forming an adiabatic taper at the optical interfaces in the device disclosed by Shintaku.

Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Okayama U.S. Patent No. 5,388,001. Refer to the appropriate drawings or parts of the specification. Okayama discloses a polarization independent optical wavelength filter with a simplified structure with a majority of the limitations of the present claim. Regarding claim 21, Okayama discloses that his interferometric device is based on a nonreciprocal phase shifter comprising a plurality of Mach-Zehnder waveguide interferometers (see fig 10 and col. 9, lines 22-23); a half-wave retarder (see col. 11, lines 29-32); and one or more Faraday rotators with a total rotation of  $45^\circ$  (see col. 7, lines 19-25). Although Okayama does not explicitly state that his device uses more than one half-wave retarder, the number of half-wave retarders used in optical isolators/circulators depends on the application. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to use more than one half-wave retarder in the device disclosed by Okayama.

#### *Allowable Subject Matter*

Claims 22 and 23 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: As to dependent claim 22, the prior art of record, taken alone or in combination, fails to disclose or



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render obvious an isolator/circulator wherein one path of each interferometer includes a half-wave retarder, wherein the slow axes of the retarders are either parallel or perpendicular to each other so that, with proper phase and power compensation between the two paths by either active or passive means, a light that enters through one of the input ports is split in the first interferometer into two linearly polarized components and recombined into one of the output ports in the second interferometer in combination with the limitations of independent claim 21. For example, Okayama discloses an optical circulator/isolator having cascaded Mach-Zehnder interferometers, a half wave-retarder, and a Faraday rotator; however, the reference fails to teach that the slow axes of the retarders are parallel or perpendicular.

As to dependent claim 23, the prior art of record, taken alone or in combination, fails to disclose or render obvious an isolator/circulator wherein at least one of the interferometers is replaced by an interferometer which has a quarter wave retarder in each path and an additional 90° path length difference between the two paths, and the slow axes of the two quarter-wave retarders are perpendicular to each other in combination with the limitations of independent claim 21. For example, Okayama discloses and optical circulator/isolator having cascaded Mach-Zehnder interferometers, a half wave-retarder, and a Faraday rotator; however, the reference fails to teach the use of quarter wave retarders, wherein the slow axes of the quarter wave retarders are perpendicular.

### *Conclusion*

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Pan U.S. Patent No. 6,289,156 discloses a low cost fiber optic circulator.

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Vahala U.S. Patent No. 6,151,428 discloses all optical wavelength coded logic gates.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daniel E Valencia whose telephone number is (703)-305-4399.

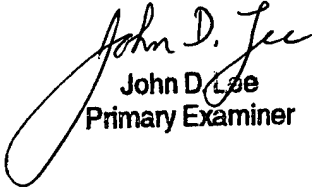
The examiner can normally be reached on Monday-Friday 9:30-6:00.

The fax phone numbers for the organization where this application or proceeding is assigned are (703)-308-7724 for regular communications and (703)-308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)-308-0956.

DV

Dan Valencia  
September 10, 2002

  
John D. Lee  
Primary Examiner